22. COTS Software Maintenance

Software maintenance procedures are current to Drop 5.0 functionality.

22.1 Introduction

The ECS organization provides maintenance and operations for ECS, software, and firmware systems delivered under the ECS contract to the ECS sites. The functions performed by each of the M&O organizations are described in the M&O Management Plan, CDRL 601-CD-001-001. M&O tasks for COTS software support are described in Section 22.1, based on 613-CD-003-001, "Release B COTS Maintenance Plan for the ECS Project" and 194-602-OP1-001, "Property Management Plan for the ECS Project."

In general, ECS organizations procure, produce, deliver, and document the modifications, and enhancements made to ECS software and firmware. No custom firmware has been identified as part of the ECS program. Commercial off-the-shelf software (COTS SW), firmware, and hardware will be maintained in accordance with the COTS Maintenance Plan, CDRL 613-CD-001-001. The Project maintenance philosophy for software is to provide ECS centralized support for developed items and vendor support for COTS SW.

Specific software support procedures are discussed in this section. ECS Project software consists of COTS, custom-developed, and science software. Science software, developed for use on the ECS project, is the responsibility of the science community (see section 22.1.3). **Work flow process chart A illustrates COTS Software License and Maintenance and can be located at the end of this chapter.**

COTS software maintenance includes:

- COTS support contract with the software vendor for license to use; telephone assistance in resolving COTS SW problems, as well as obtaining patches and upgrades.
- Services required to produce, deliver, integrate, install, validate and document modifications of existing ECS software and firmware. The maintenance activity includes: software configuration management (CM) including support for change control, configuration status accounting, audit activities, and software quality assurance (QA). Each site is the CM authority over its own resources subject to ESDIS delegation of roles for ECS management.

The site's LMC, System Administrator (SA) and Network Administrator (NA) will be advised by the ILS Maintenance Coordinator and COTS Software License Administrator on the procedures for handling COTS software upgrades and vendor liaison.

The ECS System Support Office (SSO) provides assistance when COTS software issues exceed the capabilities of the site System Administrator or the Network Administrator to resolve.

22.1.1 COTS Software Maintenance

Operations personnel at the sites accomplish installation of patches, upgrades and software problem isolation. The COTS software vendors support COTS software procured for the ECS contract. (NB: The term software vendor refers to the company having the legal right to authorize software use and to modify the software code.) COTS software vendor support consists of telephone support for resolution of usage and interface problems, access to an on-line solution database, providing upgrades and patches and resolving COTS software code problems.

The Activity Outline in Table 22.1-1 is an overview of COTS Software Support procedures and the section number where details for performing the tasks can be found. .

Table 22.1-1. COTS Maintenance - Activity Outline

Task	Section
Assist System Administrator in obtaining COTS SW support	(I) 22
Manage COTS Software Maintenance Contracts	(I) 22.1.3
Manage Software Licenses	(I) 22.1.4
Interface with CCB (SW License Admin. may go before CCB whenever there is an upgrade in current software version, new patches, or a need to purchase additional software licenses in order to satisfy project requirements. SW License Admin. Should be informed and involved in any overall change to the baseline.)	(I) 22.1.4-22.1.5
Obtain COTS Software Support	(P) 22.1.6

22.1.2 Management of COTS Software Maintenance Contracts

The ECS procurement office at the EDF contracts COTS software vendor support. After the first year of warranty support, support is contracted for a period of one or more years and extended or modified as operationally required. Information related to COTS software support contracts is maintained in a database used by the COTS Software License Administrator to monitor the expiration dates and contract terms.

For drop 5A, the COTS SW License Administrator will track software licenses via the Inventory database. As a COTS SW vendor support requirement nears its expiration date, the COTS SW License Administrator determines through consultation with the responsible organization, the need for continued COTS software support. The SW License Administrator will issue a CCR to the CCB organization. When the CCR is approved the SW License Administrator will coordinate with the ECS procurement office for extension/modification of the support contract. Requested changes to COTS SW support contracts should be provided by the site System Administrator to the COTS SW License Administrator. The COTS SW License Administrator may be contacted

by email at ilsmaint@eos.hitc.com or by dialing 1-800-ECS-DATA, Option #3, then dial extension 5180.

22.1.3 Management of COTS Software Licenses

Functions of the COTS SW License Administrator include the following:

a. Maintain accountability for all COTS SW licenses procured for the ECS contract. Accountability includes tracking and reporting the as-installed location of all licenses procured. This information will be generated from the findings of the software physical configuration audit. Once the software configuration audit has been performed, the software licenses will be tracked by monitoring the status of COTS SW CCRs as they are implemented and through configuration data maintained in Inventory Database.

b. Assist the SSO organization with the help of the SE/EDS organization in impact analysis of proposed COTS SW upgrades and patches on other COTS SW applications incorporated in the ECS system design. Maintain a database containing license keys of project-purchased COTS SW. The COTS SW installation team (or site) will provide the host identifications to the COTS SW License Administrator, who will then obtain the necessary license keys from vendors for SW installation and populating the COTS SW database.

c. The SSO organization will distribute SW upgrades, with vendor-provided release notes.

d. Keep SSO and all other ECS sites informed by providing them with the vendor maintenance necessary to access vendor patch libraries for use in resolution of software problems.

COTS software licenses vary by the type of software and the software vendors' policies. COTS software license types include: floating, per site, specific number of concurrent users, unlimited users, and lifetime use without regard to number of users or location. The quantity and type of COTS software licenses initially required are identified to the ECS procurement office by ECS design engineers. COTS software licenses are received and entered into the Inventory Database by the ILS Property Administrator. The ILS Property Administrator maintains the master copy of COTS SW license agreements (hardcopy). The COTS Software License Administrator will update the COTS software license database.

22.1.4 COTS Software Installation and Upgrades

The COTS software upgrades are subject to appropriate CCB approval before they may be loaded on any platform. The SSO Software Librarian, using procedures contained in Section 9, "Configuration Management," notifies the SSO organization of the upgrades that have been received. The SSO distributes the COTS software upgrades as directed by the CCB. The site System Administrators are responsible for upgrading the software on the host machine and providing follow-up information to the Configuration Management Administrator (CMA), SSO Software Librarian and the COTS SW License Administrator. The site LMC will notify the appropriate personnel when the COTS software is received.

COTS software patches may be provided by the COTS software vendor in response to a DAAC's call requesting assistance in resolving a COTS software problem. The problem may or may not

exist at other locations. When a COTS software patch is received directly from a COTS software vendor (this includes downloading the patch from an on-line source), the DAAC's CCB shall be informed via CCR prepared by the appropriate site personnel. It is the responsibility of the appropriate site personnel to notify the CCB of the patch's receipt, purpose, and installation status, using procedures contained in Section 9, "Configuration Management," and to comply with the CCB decisions. The appropriate site personnel will install the COTS SW patches as directed by the CCB. In addition to providing patches to resolve problems at a particular site, the software vendor will periodically provide upgrades of COTS software in order to improve the product. Such upgrades are issued to all licenses covered by a software maintenance contract. Therefore, the COTS software upgrades will be shipped to the ILS PA who receives and enters them into inventory and then forwarded to SSO Software Librarian. The SSO Software Librarian then coordinates with the COTS SW License Administrator to update the software license database once software is installed. When there is a desire to upgrade to a more current version of the software, a CCR must be submitted by the SSO Organization for approval by the appropriate CCB. Once the upgrade is approved and installed, and the CCR closed, the CM Administrator ,ILS PA and COTS SW License Administrator are notified of the configuration change for updating of ECS records. **Work Flow process charts B and B-1 illustrate software patches and upgrades and can be located at the end of this chapter**

22.1.5 Obtaining COTS Software Support

COTS SW support involves both site capability and contracted support. The site System Administrator (SA), Network Administrator (NA), and site Software Maintenance Engineer provides site capability. The COTS SW vendor provides contracted support. When the appropriate site personnel confirms that a problem is attributed to the COTS SW, the COTS SW vendor's technical support center is contacted by authorized personnel at the site.

The software vendor's technical support center will verify contract support authorization and then assist in pinpointing the COTS SW problem to provide a recommended solution. The solution may comprise of a patch, work-around, or include the fix in a future release. If a patch exists to correct the problem, the patch will be identified and provided by the software vendor over the Internet or mailed to the requester. If a patch is required but unavailable, the site and vendor together determine the seriousness of the problem. In cases where the problem is critical, a temporary patch or work-around may be provided. If non-critical, the solution to the software problem may be scheduled by the software vendor to be incorporated in a future update or release. (NB: The DAAC and ESDIS CCBs must authorize the patch to be installed as a permanent installation. This decision may be made after-the-fact. That is, if the patch is needed in order to proceed with operations, notify the appropriate DAAC personnel of the requirement in accordance with Section 9, "Configuration Management." Applicable requirements of Section 8.1, "Trouble Ticket System Procedures," must be followed.) LMC at each site will receive the software and log it appropriately in the Software Inventory.

The COTS Software License Administrator obtains the support authorization codes from the vendors and arranges for specified personnel to become an authorized contact person, based upon the limitations imposed by the vendor, and the needs of individual DAACs. The software

vendor's technical support telephone numbers, the names of personnel authorized to contact the vendor, and the authorization codes will be provided to the site's LMC by the COTS Software License Administrator through the M&O web site entitled "COTS Hardware- Software Maintenance via the following URL"

http://dmserver.gsfc.nasa.gov/ils/html/maintsw.htm.

Changes to the information in the "COTS Software Support" web site are to be provided to the COTS Software License Administrator as they occur, for updating the web site. Specifically, the need to identify or replace the authorized contact person must be provided by the LMC to the COTS Software License Administrator.

E-mail is the preferred notification method. The site will follow these steps:

a. Send e-mail to ilsmaint@eos.hitc.com.

b. If e-mail is not available, call 1-800-ECS-DATA, Option 3; then dial extension 0728.

c. Identify the change as either a permanent or temporary change. A temporary change may occur when the authorized contact person is ill, on vacation, in training, or other short-term change of work availability status has occurred or is expected to occur.

d. Provide the COTS Software License Administrator the change information as soon as it is known.

22.1.6 COTS Software Problem Reporting

The first person experiencing or observing a potential COTS SW problem will initiate a trouble ticket according to the procedures found in Section 8.1, "Trouble Ticket System Procedures" then forward it to the assigned site person to review the problem. This person will attempt to isolate the source of the problem to system configuration, hardware, network, COTS SW, custom SW, or science SW.

If it is confirmed to be a COTS SW problem, the authorized contact person should contact the vendor's technical support center for assistance. Information on contacting the software vendor's technical support center is in Section 22.1.4.1, "COTS Software Problem Reporting." The appropriate site personnel must annotate all actions inclusive of dates, time, resolutions, and comments in the Remedy Trouble Ticket as the repair progresses. COTS software corrective action reporting follows the procedures contained in Section 8, "Problem Management" and the configuration control requirements contained in Section 9, "Configuration Management," when a configuration item is removed and/or replaced with a different version or release.

One method to troubleshooting the COTS SW problem is to scan the software vendor's web site solutions database to learn of any solutions for similar problems. The software vendor's web site address can be obtained as stated in Section 22.1.6. Another manner to troubleshooting the COTS SW problem is to exercise any software diagnostic routine embedded or down-loadable that will determine the status of the COTS SW on the equipment by reviewing the troubleshooting-diagnostics and corrective actions taken to date. These troubleshooting,

diagnostics, and/or isolation procedures may be contained in the vendor's operational manuals or in locally devised troubleshooting procedures.

COTS SW problems that cannot be corrected using site and contracted software support may be escalated to the ECS SSO. The SSO is staffed with Senior Systems Engineers knowledgeable on COTS SW that can assist in diagnosing the problem.

The site Local Maintenance Coordinator may go directly to the software vendor or to the ILS Maintenance Coordinator to obtain an escalation of software vendor support if the software vendor's efforts have not produced satisfactory results within a reasonable period of time. The escalation may result in increased vendor management review of the problem resolution, the assignment of additional resources to resolve the problem, and/or a more highly qualified technician assigned to resolve the software problem. **Work flow process charts D and D1 illustrate Software Problem Reporting and can be located at the end of this chapter.**

22.2 Custom Software Maintenance

Multiple baselines may exist throughout the ECS contract. After Version 2, Release 2.0 is operational, the M&O organization may need to modify the configuration as established at each center. The M&O master library was delivered by the release development organization at launch. The Software Change Manager (ClearCase) provides the vehicle to store and maintain the library. The governing policies and minimum developed software component level that may be removed from or reintroduced to (checked-out for maintenance) the master library are defined by the developers' determination of code modules. This topic is detailed in the description of the Software Change Manager and Baseline Manager (XRP-II) tools, (Sections 9.6 and 9.9 of this document, respectively). Software changes are distributed on the basis of Software Configuration Items to the sites' copy of the Software Change Manager and recorded in the sites' copy of Baseline Manager following configuration management procedures defined in the M&O CM Plan (102-CD-001-002) and Section 9 of this document.

Maintenance changes to the ECS baseline may come from any of several sources, e.g.,

- ESDIS CCB directed changes
- Site-level CCB directed changes to Configuration Items (CIs)-- ESDIS will delegate or define which items are to be under site-level control and to what extent those parameters can be changed.
- Developer scheduled modifications or upgrades.
- User or operator initiated Trouble Tickets.

Trouble Tickets (TTs) are written by ECS users, operators, and system administration to address any level of problem they may encounter with a minimum required level of documentation. This topic is addressed in more detail by the ECS Developed SW Maintenance Plan (614-CD-001-002) at section 4.3 and in this document at section 8 "Problem Management." Most of these problems will be fixed locally with minimum overhead requirements for tracking and analysis. The TT Telecon will be used by the SEO to discuss system-level issues that may

(a) coordinate groups of TTs,

(b) affect more than a single site,

(c) will be referred back to the ESDIS Project Office and the ECS development organization,

(d) and will be worked-off with the necessary coordination and formality of multi-site change or implementation.

The Software Maintenance Engineer records all actions to resolve a problem on the associated trouble ticket within the TT System tool (Remedy). ClearCase serves as the Software Change Manager, providing utilities to maintain a software master library (the operational baseline) and supporting CM functions for version control. The Software Maintenance Engineer can check-out software components for maintenance and check them in for baselining. The Software Change Manager tracks versions of software used in builds as well as provides a tool to perform builds.

Updates to baselined custom software are submitted with the Version Description Documents (VDD) and go through the CCB review process. The software also goes through M&O testing prior to installation. All changes to the operational baseline are recorded and tracked in the Baseline Manager by the CM Administrator (see Section 9 of this document).

The Activity Checklist table that follows provides an overview of Custom Software Support procedures. Column one (**Order**) shows the order in which tasks might be accomplished. Column two (**Role**) lists the Role/Manager/Operator responsible for performing the task. Column three (**Task**) provides a brief explanation of the task. Column four (**Section)** provides the Procedure (P) section number or Instruction (I) section number where details for performing the task can be found. Column five (**Complete?**) is used as a checklist to keep track of which task steps have been completed.

Table 22.2-1. Custom Software Maintenance - Activity Checklist

Order	Role	Task	Section	Complete?
1	Software Maintenance Engineer/CMA	Implementation of Modifications	(I) 22.2.1	
2	SEO	Test Plans & Procedures	(I) 22.2.2	
3	M&O Test Team	Custom SW Installation	(I) 22.2.3	
4	CCB	Scheduling the Release	(I) 22.2.3.1	
5	CMA	Operations & User Notification	(I) 22.2.3.2	
6	SW Maintenance Engineer	Maintenance Changes to the SW Change Manager (ClearCase) Library	(I) 22.2.3.3	
7	SW Maintenance Engineer	Creating SW Build Using the SW Change Manager	(I) 22.2.3.4	
8	CMA & SW Maintenance Engineer	Promoting SW Using the SW Change Manager	(I) 22.2.3.5	
9	SW Maintenance Engineer	Installing the New Release	(I) 22.2.3.6	
10	M&O Team	Obtaining SW Support	(I) 22.2.4	
11	User Services, CMA, Operators	SW Problem Reporting	(I) 22.2.4.1	
12	Problem Investigator	Troubleshooting	(I) 22.2.4.2	
13	SW Maintenance Engineer	Corrective Action Reporting	(I) 22.2.4.3	
14	Science SW Team	Resolve problems, as required	(I) 22.2.5	

22.2.1 Implementation of Modifications

Implementation of changes is performed using a controlled build procedure. For each build, each ECS organization selects a responsible engineer (RE). The SEO RE establishes the set of CCRs to be included in the system build. The ECS On-Site, SMC and EOC REs determine which, if any, site-unique extensions are to be applied to the system build. Schedules for implementation, integration, and test at the system and center levels are established. The SEO RE maintains the integrated system and center-specific CCR list and schedule.

The SEO RE maintains the Version Description Document (VDD) that contains:

- The CCRs incorporated into the build and their operational and/or user features
- The build schedule,
- ECS external interfaces affected by the build,
- ECS CIs affected by the build,
- List of ECS documentation (e.g., design documents, procedures, help files, etc.) affected by the build,
- Test program results summary, and
- Test team recommendation.

The initial VDD is provided with Version 2, Release 2.0 by the Independent Acceptance Test Organization. It is then maintained by the Sustaining Engineering Office (SEO) as described in the Developed SW Maintenance Plan, 614-CD-001-003 at Sections 4.3.6 and 4.3.7. It contains not only the as-built documentation, but is supplemented by the as-tested, verified, and accepted documentation as discussed in the Acceptance Testing Management Plan. The document is described in the System Implementation Plan for ECS Turnovers, ECS #301-CD-003-001 which addresses the overall ECS system turnover process (HW, SW, and documents). The SEO RE updates depend on authorized changes.

Appendices are added as necessary to the system level VDD by each center's RE to describe any center-unique additions/modifications to the build. The VDD is published in draft form well in advance of the build using ECS bulletin boards and electronic distribution. Updates are published as information is gathered. The final VDD is published just prior to installation of the new build into operations.

For a given CCR, the RE (or designated team) to whom implementation of the CCR is assigned uses the configuration controlled local library to obtain the correct version of the source code/files. Using ECS-provided editors, compilers, and build procedures, the RE implements the change, performs programmer testing, and updates the documentation including design, interface, and procedure documents.

The RE may discover that the approved incorporation schedule cannot be met because of unforeseen complexity, changes in priority, or conflicting assignments. Revised implementations, priorities and schedules are brought to the CCR Telecon for discussion. If necessary, a revised

CCR and/or incorporation schedule is forwarded to the ESDIS CCB for impact assessment. Typical CCR discussion topics are outlined in Figure 22.2-1.

CCR Discussion Topics

- Review and prioritize each CCR opened at each center
- Review and re-prioritize older CCRs (as required)
- Review status of open CCRs
- Review distribution of CCRs by organization, status, priority and age
- Recommend new/revised assignments of CCRs to organizations/centers
- Discuss CCR issues with development organizations

Figure 22.2-1. Typical CCR Telecon Agenda

Upon completion of the modification, the revised source files, data bases/ structures, and documentation are impounded and controlled by the Integration and Test organization at the RE's site using the CM tool. The impounded material is forwarded (if developed at a DAAC, the SMC or EOC) to the SEO for system integration and test. In the case of FOS SW CIs, system integration and test is performed within the EOC.

The golden copy of ECS SW is maintained by the SMC. Required access to the golden copy as well as changes will be guaranteed by logging changes and backing up modifications for later access as required by users, developers, and maintenance personnel under CM guidelines delineated by the ECS CM Plan. SW will also be maintained by local CM at the DAACs.

22.2.2 Test Plans and Procedures

The objective of the test program is to ensure that the CCRs are properly implemented and that defects have not been introduced as a result of the changes. Therefore, both feature (has the CCR been properly implemented) and regression (revalidation of proper operation of the CI and system) testing at both the system and center levels are critical parts of the test program.

The test function exists within each of the M&O organizations. In the larger organizations, individuals may be dedicated to testing of M&O builds. In the smaller organizations, testing may be an performed by personnel who have additional assignments. The test team can include maintenance programmers, vendors, users — any personnel who reported the problem that initiated the upgrade or who use the software. Regardless, the guiding principle is that the maintenance programmer who made a change is not allowed to be the only person who revalidates the program or provides feature testing.

The methodology employed in testing includes:

- Inspection — formal verification by examination of the assembled CI and its design documentation.

- Analysis — formal verification by examination and study of the CI/data base/data structure design and coding.
- Demonstration — formal verification by operating the computer program.

  eview of test records and data after the execution of the computer program.

These are categories of testing procedures. The specifics cannot and should not be pre-determined, but rather should be responsive to the individual requirements determined by the extent/ impact of changes made to the original CI. M&O testing shall consist of recreating in whole or in-part the same scenarios used in the original acceptance testing.

Using the information in the Version Description Document (VDD) described in Section 22.2.1, the system and center test teams develop test plans for the build. The plans describe:

- The CCRs to be tested;
- The CM baseline(s) to be used;
- The requirements and features to be verified;
- The method of verification including identification of test cases/data sets;
- Acceptance criteria;
- Resource requirements; and
- Schedule of testing.

that are to be used for both feature and regression testing. Test procedures provide the detailed scenarios and test cases/data sets, steps, operator/user actions, analyses, etc., that implement the test plan.

Feature testing is performed through either the development of new test cases and data or the modification of existing test cases and data. Regression testing is performed using standard test cases with expected test results. When possible, the same test cases and data as were used when the program was originally developed are used. Test cases developed for prior feature testing are also used as part of the test program.

When possible, center-specific testing of system-level change builds will be performed in conjunction with the system test. If this is not possible, center-specific testing will precede the system level testing to allow a controlled increase in complexity during the test program. Should center-specific modifications to the system build be required, center level testing will be performed at the center first and then included in either the initial or follow-on system-level testing.

Test results and analyses which are developed by the test organization(s) are provided to the SEO and center REs. Unacceptable performance during the test program may result in delaying of the entire build or removal of a CCR from the build. Because the test team functions as an independent assessment of the build, it provides its recommendation on the quality and

performance of the build to the SEO. A summary of the test program and the test team's recommendation are added to the VDD.

The SEO RE is responsible for review of the test plans and procedures to ensure the adequacy of the test program. Center REs support the SEO RE in this assessment. Status of the test program is also provided to ECS and center management at the weekly status meetings described in Appendix B of the Maintenance and Operations Management Plan.

22.2.3 Custom Software Installation

The Version Description Document (VDD) provides the summary documentation package for each build. The material in the VDD is presented by the ECS M&O test function to the appropriate individual(s) within ESDIS. The VDD material is also presented by the ECS M&O test organization to the appropriate individual(s) within each operational center. If required by ESDIS or the center, results of IV&V or center-unique testing results will be presented by the appropriate organization. Upon review and approval by ESDIS and center management, the build as baselined in the center-specific VDD is authorized for system-wide and center operations.

The following sequence then occurs:

- The VDD undergoes final updates for system and center-specific material identified by ESDIS or the operational centers (e.g., IV&V test results and recommendations, center by center operational installation schedule, etc.).
- The final VDD is published.
- In accordance with the installation schedule, the build is installed at each center along with operational and user documentation updates.
- Controlled Document updates are provided to Document Maintenance and entered into the CM system.
- The CM system is updated to indicate the M&O system and center-specific baselines.

22.2.3.1 Scheduling the Release

Scheduled maintenance should be emphasized as a method of controlling the maintenance function in which the new-release concept already applied to systems is also applied to typical application programs. Emergency fixes are applied as required, but all other repairs or changes are assessed for the determination of an appropriate new-release schedule. There are several benefits to this approach:

--By consolidating the changes to be made to a CI, modifications can be performed more efficiently, e.g., documentation is updated only once, minimizes unnecesary disruptions to ops, decreases costs, etc.

--Since users know their changes will not be acted on immediately, they can give more consideration to which changes they actually need.

--Batched changes can be assessed holistically and more thoroughly evaluated.

--Knowing which applications will be maintained during the monthly/yearly cycle enables management to more effectively prioritize maintenance projects

--Positive control of baseline management between the M&O and Development organizations

22.2.3.2 Operations and User Notification

The Version Description Document (VDD) is the vehicle for communicating the contents, status, feature, schedule, and test results to the ECS stake holders. It is supplemented by test plans, test procedures and test results. Draft and final versions of the VDD and test program documentation are published and distributed to interested organizations internal (e.g., the ECS Development Offices, System Management Office, Quality Office, Science Office, etc.) and external (e.g., ESDIS, DAAC, other Customer, external systems, IV&V contractor, SCFs, user groups, etc.) to the ECS Contractor using ECS bulletin boards and electronic distribution.

22.2.3.3 Maintenance Changes to the On-Site SW Change Manager Library

The golden copy of ECS custom software is maintained at the SMC by the SEO CM Administrator. Required access to the golden copy as well as changes will be guaranteed by logging changes and backing up modifications for later access as required by users, developers, and maintenance personnel under CM guidelines delineated by the M&O CM Plan. Custom software will also be maintained by the CMA at the ECS deployment sites.

The Software Maintenance Engineer (SME) will use the Software Change Manager (ClearCase) to maintain the current software baseline. The CMA and SME will maintain the records in Baseline Manager so that they are synchronized with the Software Change Manager maintenance changes.

SMC provides the upgraded or new custom software to the sites. Each site specifies a temporary directory (a ClearCase VOB) that will receive the software. The site CCB must approve the installation of the software into the site's master library.

When notified by the CMA that the source code has been received and baselined, the Software Maintenance Engineer creates branches in the Software Change Manager, which are created for bugfixes, enhancements, and new development that are under CM control. The Software Maintenance Engineer also sets the configuration specification for the operational environment. Lastly, the Software Maintenance Engineer merges the files.

Refer to the procedures in ECS Work Instruction CM-1-016-1 to manage the branch and merge process.

22.2.3.4 Creating the SW Build Using SW Change Manager (ClearCase)\

Refer to the procedures in ECS Work Instruction CM-1-023-1 to manage creation of the software build using ClearCase.

22.2.3.5 Promoting Software Using SW Change Manager (ClearCase)

Tables of SW states (Table 22.2-2 for ECS SW and Table 22.2-5 for Science SW); valid SW state transitions (Table 22.2-3 for ECS SW and Table 22.2-6 for Science SW); and SW promotion levels (Table 22.2-4 for ECS SW and Table 22.2-7 for Science SW) govern the promotion of ECS custom and science SW from developer or maintenance engineering activities into operational strings. SW Change Manager (ClearCase) scripts execute the transition queries, notification and changes under CM control as explained in Sections 22.2.3.5.1 and 22.2.3.5.2.

22.2.3.5.1 "Change State Script" Description

The Change State script is designed to provide configuration management support of software undergoing change. Software versions will have a state attribute assigned to facilitate the tracking of a version as it proceeds through its lifecycle stages. This script will give its user the capability to change the value of the state attribute of a file version as the version proceeds from one state to another. This script checks the entered state attribute value and allows only valid state values to be processed. It checks the user's identification and allows only designated user(s) to change the state attribute value. It checks to ensure that the entered state value is a valid transition from the file version's current state attribute's value, informs the user of unexpected transitions, and gives the user the option to proceed with the transition, anyway. It notifies appropriate personnel that the version is ready for system test, acceptance test, or production. It will also assign a state value of ready for supersession and superseded for those versions of files that are being or have been replaced. Valid state values, valid state transitions, personnel authorized to change state values, and personnel to be notified of state changes are stored in files.

22.2.3.5.2 Promotion_level Script Description

The Promotion_level script is designed to provide configuration management support of software undergoing change. Software versions will have a Promotion Level attribute assigned to facilitate the tracking of a version as it proceeds through its lifecycle stages. This script will give its user the capability to change the value of the Promotion Level attribute of a file version as the version proceeds from one promotion level to another. It checks the entered Promotion Level attribute value and allows only valid promotion level values to be processed. Maintenance, system test, acceptance test, and Production are the valid promotion level values. This script also checks the user's identification and allows only designated user(s) to change the promotion level attribute value. It allows the designated user to promote the software version and it sets the initial state attribute value for the entered promotion level value. Valid promotion level values and personnel authorized to change these values are stored in files.

Table 22.2-2. ECS Software Oriented Tables State Table

State	Authority to Change State	Person to be Notified	In Promotion Level
In_Work	Developer		Maintenance
Ready for Inspection	Developer	Lead Engineer	Maintenance
Inspected	Lead Engineer		Maintenance
Ready for System Test	Lead Engineer	Tester	Maintenance
In Sys_Testing	Tester		System_Test
Sys_Tested	Tester		System_Test
Ready for Acceptance Test	Tester	Accept. Tester	System_Test
In_Accept_Testing	Accept. Tester		Accept_Test
Accept_Tested	Accept. Tester		Accept_Test
Ready for Release	Accept. Tester CM_Admin	CM_Admin	Accept_Test
Released	CM_Admin		Accept_Test
Ready for Production	CM_Admin	Sys_Admin	Accept_Test
In_Production	Sys_Admin		Production
Ready for Supersession	CM_Admin,		Production
Superseded	CM_Admin		

Table 22.2-3. Valid State Transitions

Current State	New State
In_Work	Ready for Inspection
Ready for Inspection	Inspected
Inspected	Ready for Sys_Test
Ready for Sys_Test	In_Sys_Testing
In_Sys_Testing	Sys_Tested
Sys_Tested	Ready for Accept_Test
Ready for Acceptance_Test	In_Acceptance_Test
In_Acceptance_Test	Acceptance_Tested
Accept_Tested	Ready for Release
Ready for Release	Released
Released	Ready for Production
Ready for Production	In_Production
In_Production	Ready for Superseding
Ready for Superseding	Superseded
Superseded	(No Transition)

Table 22.2-4. Valid State Assignment Given Current Promotion Level

Promotion Level	State
Maintenance	In_Work
Maintenance	Ready for Inspection
Maintenance	Inspected
Maintenance	Ready for System Test
Sys_Test	In_Sys_Testing
Sys_Test	Sys_Tested
Maintenance Sys_Test	Ready for Accept_Test
Accept_Test	In_Accept_Testing
Accept_Test	Accept_Tested
Accept_Test Sys_Test Maintenance	Ready for Release
Accept_Test As_Delivered	Released
As_Delivered Accept_Test Sys_Test Maintenance	Ready for Production
Production	In_Production
As_Delivered Production Accept_Test Sys_Test Maintenance	Ready for Supersession
Production	Superseded

Table 22.2-5. Science Software Oriented State Table

State	Authority to Change State	Person to be Notified	In Promotion Level
in work	SDPS/W		maintenance
ready for stand-alone test	SDPS/W	SDPS/W	maintenance
in stand-alone testing	SDPS/W		stand-alone test
stand-alone tested	SDPS/W		stand-alone test
ready for integrated test	SDPS/W	SSI&T	stand_alone test
in integrated testing	SSI&T		received by DAAC
integration tested	SSI&T		received by DAAC
ready for acceptance	SSI&T	CM_admin	received by DAAC
impounded for acceptance	CM_admin		delivered from SSI&T
ready for production	CM_admin		delivered from SSI&T
in commissioning	CM_admin		production
in full production	CM_admin		production
ready for superseding	CM_admin		production
superseded	CM_admin		production

Table 22.2-6. Science Software Oriented Valid State Transitions

Current State	New State
in work	ready for stand-alone test
ready for stand-alone test	in stand-alone testing
in stand-alone testing	stand-alone tested
stand-alone tested	ready for integrated test
ready for integrated test	in integrated testing
in integrated testing	integration tested
integration tested	ready for acceptance
ready for acceptance	impounded for acceptance
impounded for acceptance	ready for production
ready for production	in commissioning
in commissioning	in full production
in full production	ready for superseding
ready for superseding	superseded
superseded	(no transition)

Table 22.2-7. Science Software Oriented Promotion Table

Promotion Level	Authority to Promote	State
from SCF	CM_admin or SDPS/W	
maintenance	SDPS/W (checkout & checkin)	in work ready for stand-alone test in stand-alone testing ready for integrated test in integrated testing ready for acceptance ready for production
stand-alone test	SDPS/W	in stand-alone testing stand-alone tested ready for integrated test ready for acceptance ready for production
received by DAAC	SSI&T	in integrated testing integration tested ready for acceptance ready for production
delivered from SSI&T	CM_admin	impounded for acceptance ready for production
production	CM_admin	in commissioning in full production ready for supersession superseded

22.2.3.6 Installing the New Release

This procedure describes the steps that are executed to perform a SW upgrade on an ECS Host. The personnel involved are Sustaining Engineer (SE), Resource Manager (RM), Production Monitor (PM), and Host Operator (HO). The RM notifies the affected operators that there is an upgrade scheduled and the resources will be coming down for the installation activity. The RM then checks with the production montior to begin unloading the target resources (if Autosys has already scheduled this event, it will happen automatically). The Production Monitor then checks the current load on target resources and informs the RM that the production jobs are complete. The RM then takes the initiative to shut down any processes that may still be running and begins shut-down procedures. Then by monitoring HP OpenView, the RM and SE are notified that the host has gone off-line. The SE uses the install script to install the upgrade, verifies the path and directory structures, and runs all diagnostic tests. The SE then informs the RM that the installation is complete. The RM then initiates the host start-up commands. HP OpenView then indicates that the host is back on line.

The assumptions underlying this procedure are as follows:

(1) The upgrade has been previously scheduled and noted in the resource plan.

(2) The SW upgrade package was obtained from Tivoli Courier including any associated install scripts/makefiles.

(3) The detailed steps for installation have been provided in the VDD accompanying the SW package.

(4) The reconfiguration to minimize impact to existing operational resources has been defined.

The following table contains detailed steps of the on-site SW installation procedure.

Table 22.2-8. Detailed Steps of SW Installation

Step	Operator Action	System
1	Resource Manager composes an information message to the affected operators stating that the affected resources will be taken down as scheduled.	
2		Displays information message on consoles.
3	RM asks production monitor to verify that the production has completed on the resource as planned.	
4	PM checks current load on target resources.	Provides display of current jobs running on requested production resources.
5	PM informs RM that production jobs are complete.	
6	RM now takes control and shuts down any processes still running on impacted host(s).	
7	RM begins shut down procedures to take host off-line.	The host receives the command and goes off-line.
8		HP OpenView detects the change and changes the state to “off-line.”
9		HP OpenView sends a status message to all of the affected operators indicating that the host has gone down and changes the corresponding icon to the down state.
10	RM receives a message from HP OpenView indicating that the desired host has gone off-line. All operators monitoring the host receive a message from HP OpenView indicating that the designated host has gone off-line. Sustaining Engineer receives a message from HP OpenView indicating that the designated host has gone off-line.	

Table 22.2-8. Detailed Steps of SW Installation (continued)

Step	Operator Action	System
11	RM views the change in HP OpenView and notifies the Sustaining Engineer that the host is available for upgrade.	
12	SE uses the developers' install script stored in SW Change Manager (Clearcase).	ClearCase executes the named install script which applies controlled file system changes to the specified host.
13	SE verifies that all of the paths and directories structures have been created and are correct.	Host lists its file system contents.
14	SE runs all of the diagnostic tests to verify that the new upgrade is operating as expected.	
15	SE informs the RM that the upgrade is completed	
16	RM acknowleges the message from the SE that the installation is completed.	
17	RM initiates the host start-up commands.	Host receives the commands and begins start-up.
18		Start-up completed.
19		HP OpenView detects the state change and changes the icon to the up status and sends a status message to all users indicating that the host is back on-line.
20	RM, Operators, and SE receives message from HP OpenView indicating that the host is back on-line.	

22.2.4 Obtaining Software Support

The Baseline Manager tool will contain the list of Responsible Engineers for the SW CIs. On-site Maintenance Engineers will consult with experts from the Sustaining Engineering Organization who perform system-level SW maintenance activities and REs who will lead troubleshooting activities of specific CIs. This point of contact information will be currently maintained in the databases. Prioritized Trouble Tickets will be used to coordinate this activity and provide emergency fixes and related Configuration Change Requests will sponsor permanent changes.

22.2.4.1 SW Problem Reporting

Anomalies, the apparent incorrect execution of an ECS CI, and inefficiencies, sub-optimal use of system resources, are documented using TTs. A TT may be submitted by users, operations, customer, analysis, maintenance and management staff. At the time of TT submittal, supporting information and data is captured by the ECS staff. SW problems will be reported via the Trouble Ticket system discussed in Section 8.

22.2.4.2 Troubleshooting

Troubleshooting will be conducted on an ad hoc basis. The site-level activity will be initiated by the Operations Supervisor assigning a Trouble Ticket to the Problem Investigator as discussed in section 8.2 Problem Resolution procedures. This process is supported by SEO Maintenance Programmers, REs, and ECS Developers at the ECS Development Facility (EDF). The EDF will have the same SW and computer equipment variants available at the sites. They may be capable of duplicating anomalies experienced in the on-site's system to derive effective resolutions and/ or work-arounds as required until a permanent resolution is implemented.

At the TT telecon, the TT is prioritized and assigned by the Failure Review Board to an organization for work-off. A Responsible Engineer (RE) is assigned to work-off the TT. Using the captured data, a technical investigation is performed to attempt to isolate the source of the reported anomaly or inefficiency.

If the problem is caused by a non-ECS element (e.g., an interface problem with an external system, poor resource usage by a science algorithm, poor performance by a non-ECS service, etc.), the TT and supporting material is provided to the maintainer of that element. An ECS CCR may also be proposed to protect ECS from potential threats of future problems identical or similar to that documented in the TT. CCRs are discussed in detail at section 9 of this document.

If the TT is properly written against an ECS element, one or more of the following actions are taken:

- Describe the source of the problem and the recommended design/implementation change. Procedure modifications may also be appropriate.
- Modify procedures. Describe the source of the problem and modify procedures to eliminate or reduce the number of occurrences of the documented problem. Modifications may be temporary (i.e., work-arounds) or permanent. If the change is permanent, the TT can be closed and/or a User Recommendations Data Base (URDB) input generated.
- Track. The technical investigation focuses on collection of additional data from new occurrences to support additional analyses into the root of the problem and/or the frequency of occurrence. As a result of tracking, further technical investigations may result in any of the other actions.
- Re-prioritize. Describe the results of the technical investigation and recommend a priority change at the TT Telecon. A lowered priority may result in the TT going into backlog status or being closed. A higher priority may result in additional resources being applied to the technical investigation.
- Close with URDB input. The technical investigation may discover that what is being reported as a problem is actually the proper implementation of the feature based on the requirements baseline. A URDB input documents a recommended requirements change.
- Close TT into existing TT or CCR. If the TT documents a known problem for which no solution has been identified, the new TT can be closed into the existing TT. Supporting material from the new TT is added to that previously collected. The TT may also be

closed into a CCR that has been previously written but not yet installed into the operational baseline.

The originator of the TT is kept informed throughout the process via minutes from the TT telecon and voice/ e-mail status reports from the RE.

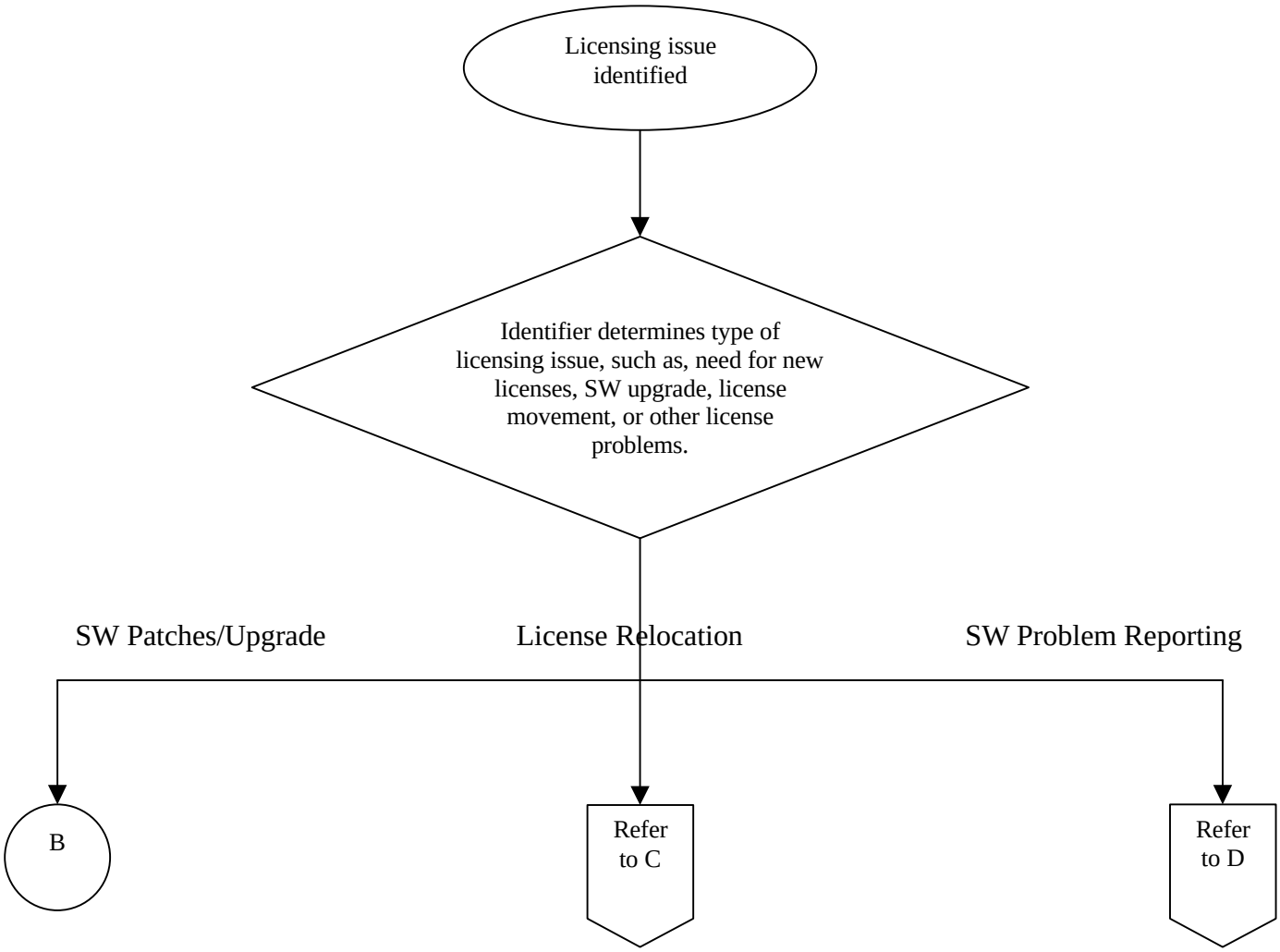
22.2.4.3 Corrective Action Reporting

Trouble Tickets will be used to document SW problems as noted in Section 22.2.4.2. The results are tallied against SW Configuration Items to determine critical maintenance concerns related to frequency of occurrence, criticality level, and the volume of problems experienced. The maintainability analysis will guide critical changes, volume and type of support components to be utilized, and focus of further ECS release development.

22.2.5 Science Software

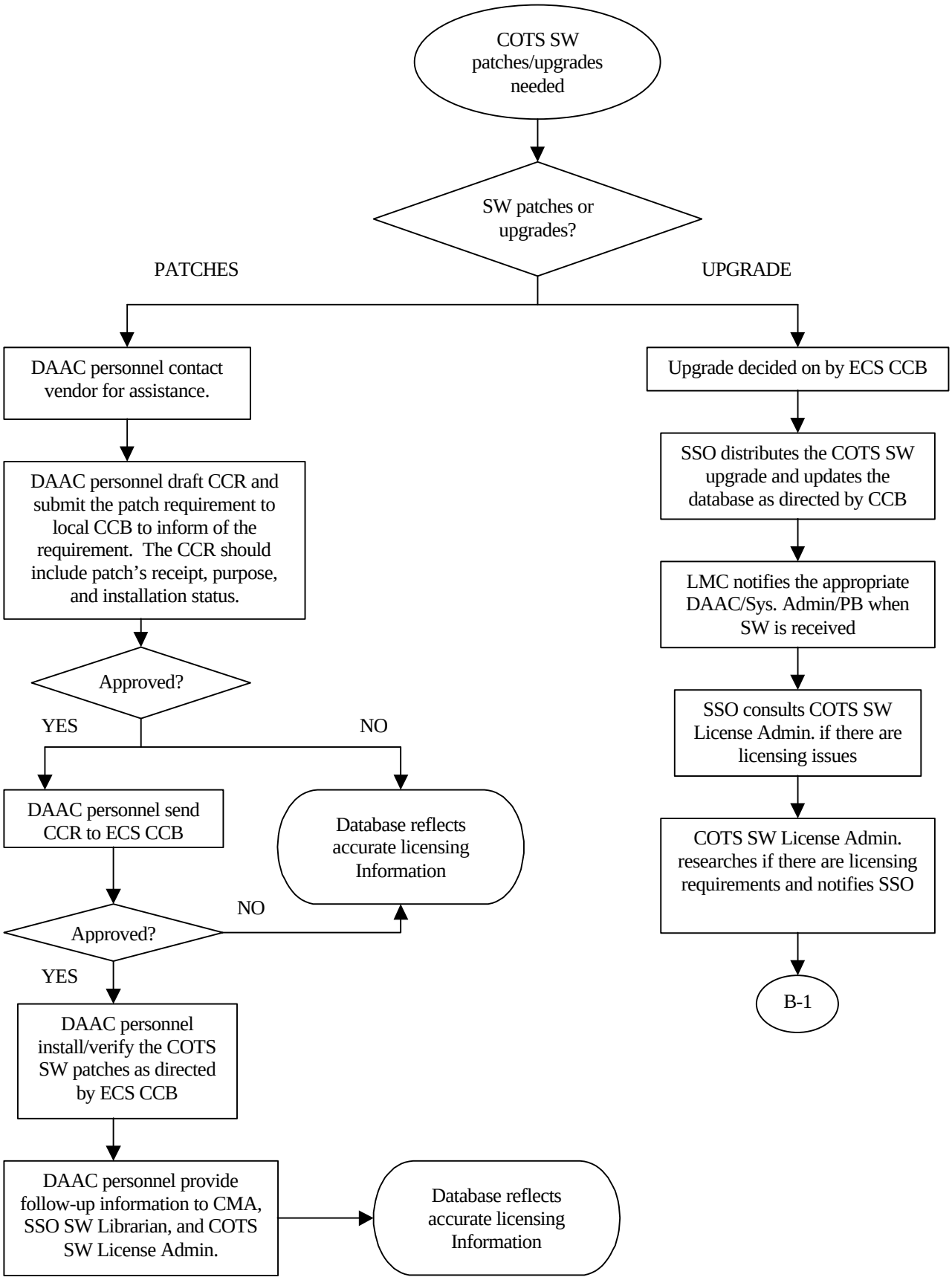
The maintenance of science software and data items provided by the Science Computing Facilities (SCFs) is not the responsibility of the ECS on-site maintenance engineers. Problem resolutions and changes to science software sponsored by the SCFs shall be introduced under the auspices of local DAAC configuration management activities and the Earth Science Data and Information System (ESDIS) (GSFC Code 505) CCB in the same manner as new releases to baselined science software. On-site changes or updates shall be integrated and tested by the Science Software Team. Ongoing CM of ECS integrated science software will be accomplished by the same tool set used for ECS developed software as explained in the Developed SW Maintenance Plan at Section 3.3 *Standardization of Support Procedures* under local DAAC control.

COTS Software License and Maintenance

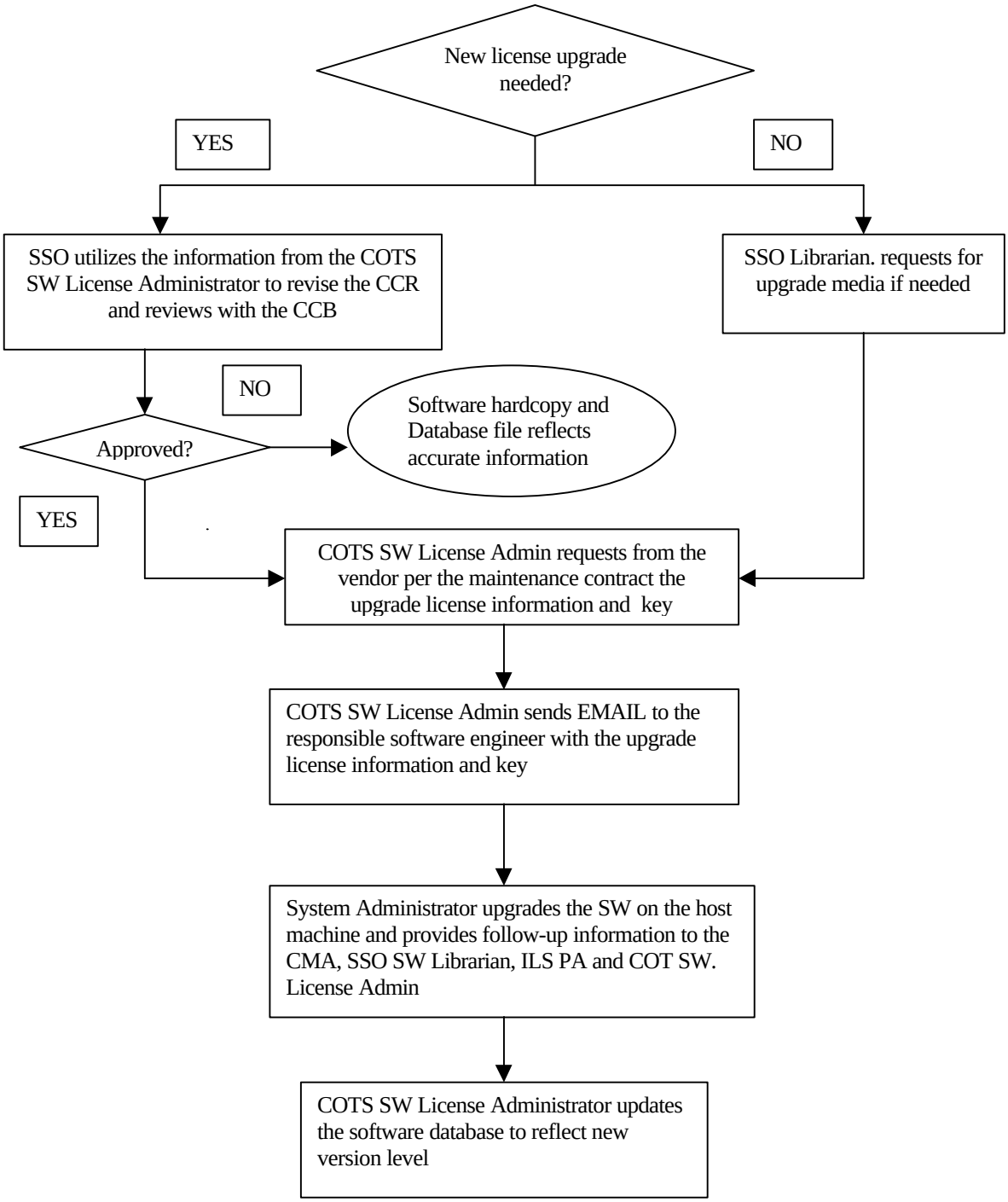


A

COTS Software Patches and Upgrades (1 of 2)

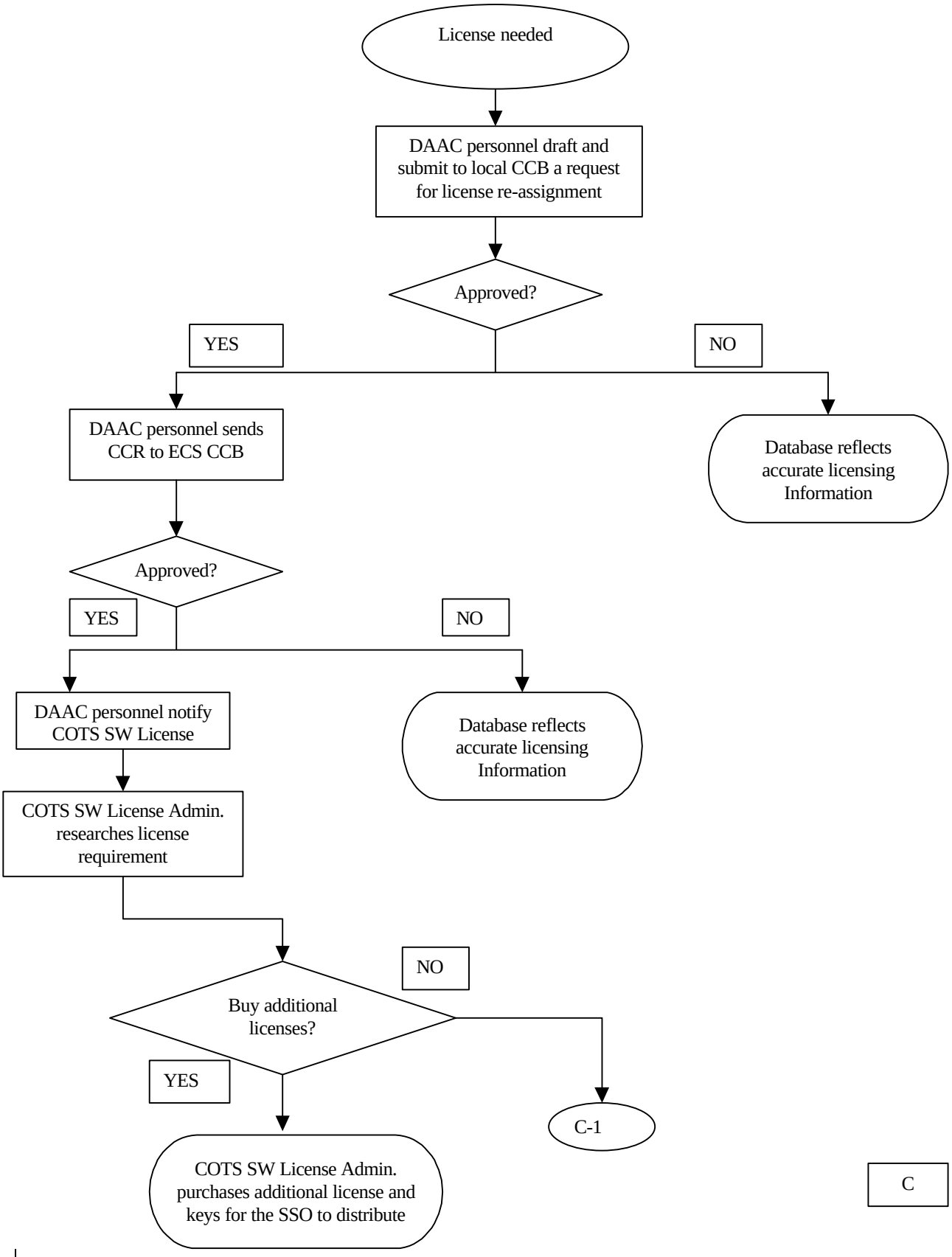


COTS Software Patches and Upgrades (2 of 2)



B-1

COTS License Relocation/Installation (1 of 2)



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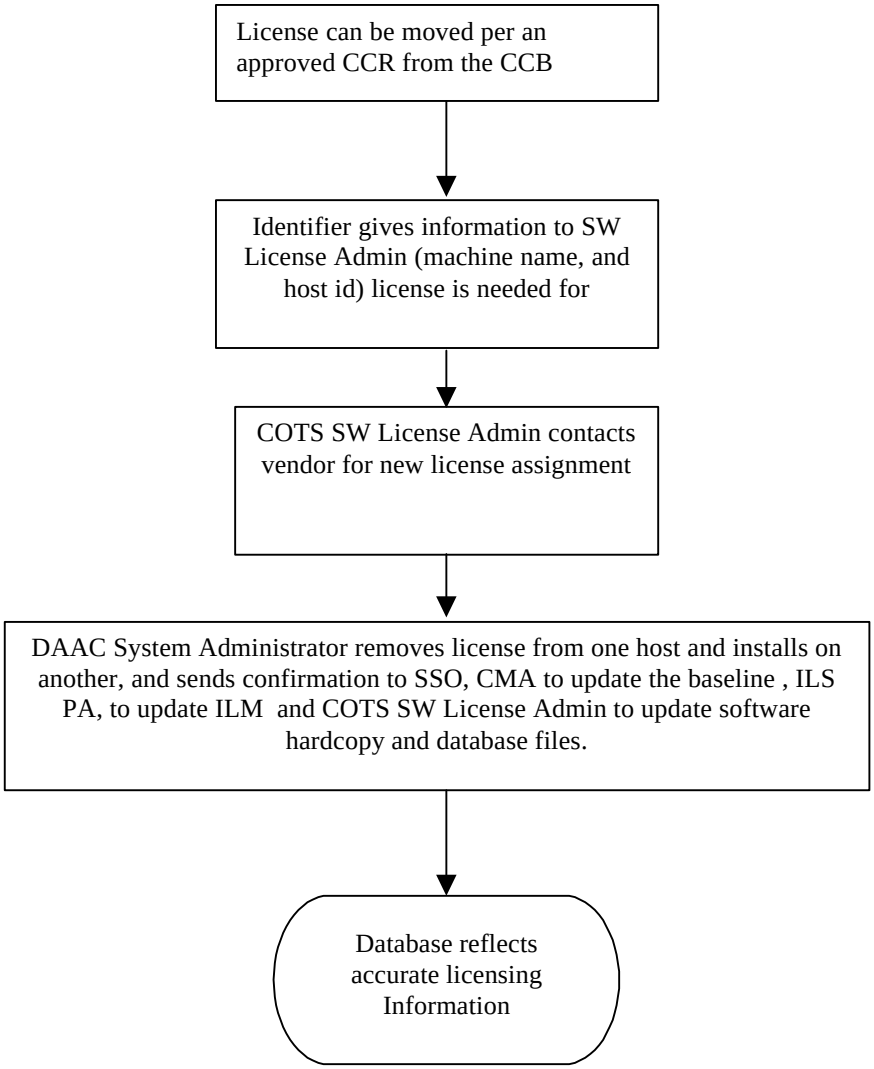
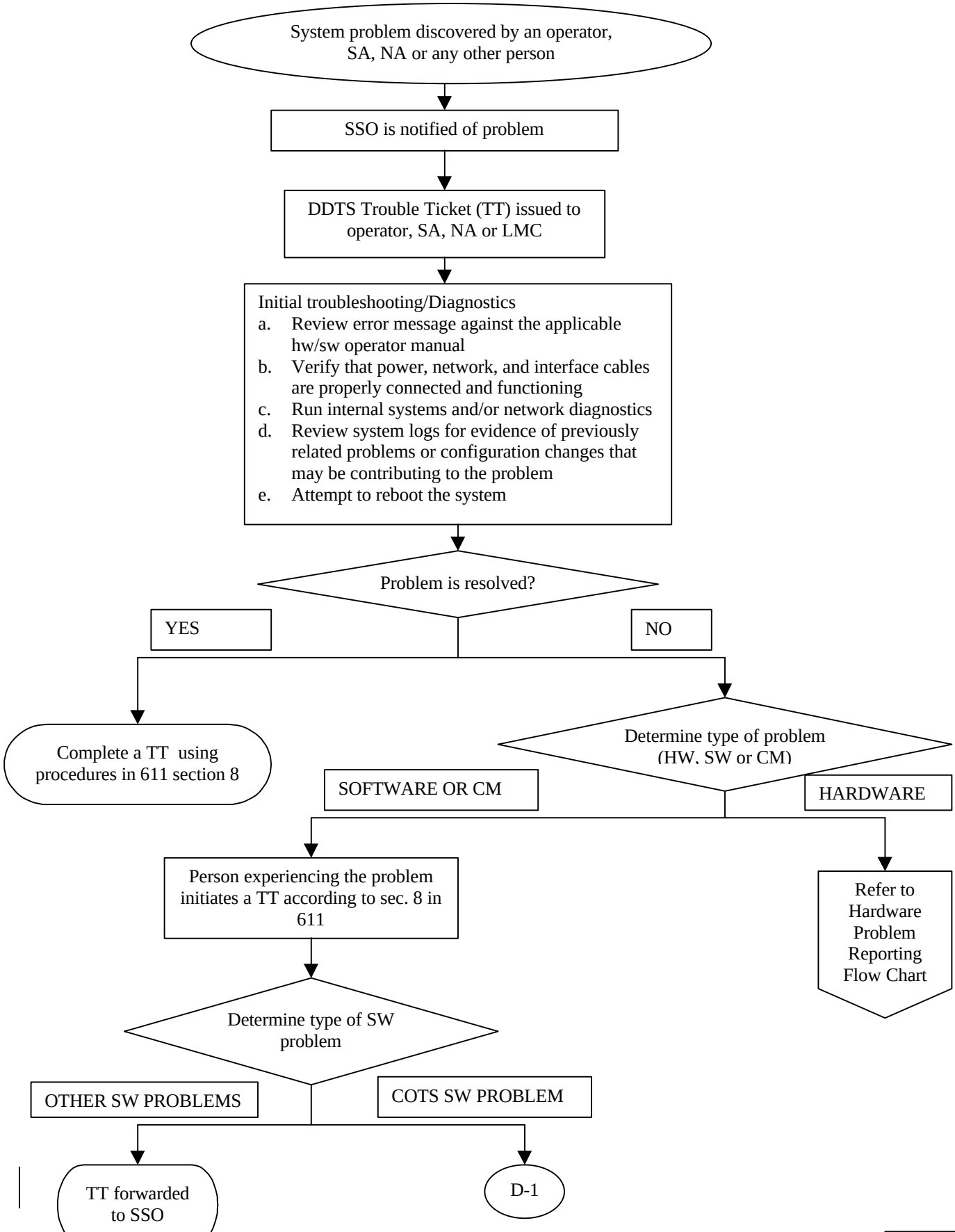


COTS Software Problem Reporting (1 of 2)



COTS Software Problem Reporting (2 of 2)